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Ethnic disparities in undergraduate pre-clinical and clinical performance

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CONTEXT Research from numerous medical schools has shown that students from ethnic minorities underperform compared with those from the ethnic majority. However, little is known about why this underperformance occurs and whether there are performance differences among ethnic minority groups.

OBJECTIVES This study aimed to investigate underperformance across ethnic minority groups in undergraduate pre-clinical and clinical training.

METHODS A longitudinal prospective cohort study of progress on a 6-year undergraduate medical course was conducted in a Dutch medical school. Participants included 1661 Dutch and 696 non-Dutch students who entered the course over a consecutive 6-year period (2002–2007). Main outcome measures were performance in Year 1 and in the pre-clinical and clinical courses. Odds ratios (ORs) with 95% confidence intervals (CIs) were estimated by logistic regression analysis for ethnic subgroups (Surinamese/Antillean, Turkish/Moroccan/African, Asian, Western) compared with Dutch students, adjusted for age, gender, pre-university grade point average (pu-GPA), additional socio-demographic variables (first-generation immigrant, urban background, first-generation university student, first language, medical doctor as parent) and previous performance at medical school.

RESULTS Compared with Dutch students, Surinamese and Antillean students specifically underperformed in the Year 1 course (pass rate: 37% versus 64%; adjusted OR 0.40, 95% CI 0.27–0.60) and the pre-clinical course (pass rate: 19% versus 41%; adjusted OR 0.57, 95% CI 0.35–0.93). On the clinical course all non-Dutch subgroups were less likely than Dutch students to receive a grade of ≥ 8.0 (at least three of five grades: 54–77% versus 88%; adjusted ORs: 0.17–0.45).

CONCLUSIONS Strong ethnic disparities exist in medical school performance even after adjusting for age, gender, pu-GPA and socio-demographic variables. More subjective grading cannot be ruled out as a cause of lower grades in clinical training, but other possible explanations should be studied further to mitigate the disparities.

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INTRODUCTION

In recent decades, student populations in medical schools in Western societies have become more diverse with respect to ethnicity and social background.[1,2] The entry of more students from non-traditional backgrounds raises questions of whether these new groups of students have similar chances of success in medical school as students from more traditional backgrounds. If students from particular groups are more likely to fail than other students, it is important to know why and when they are at risk and, subsequently, what medical schools can do to reduce the risk for failure. Answers to these questions are important not only from the perspective of equal opportunities policies, but also from a pragmatic point of view: each medical student's training involves significant investment by both the student and society.

A recent systematic review and meta-analysis showed that UK medical students from minority ethnic groups academically underperform throughout medical school compared with their White counterparts.[3] Similar results have been reported for Year 1 ethnic minority students in Australia[4] and final-year ethnic minority students in both Australia and the USA.[5,6] Despite this accumulating evidence of underperformance by ethnic minority students throughout medical school, it is still not clear why it occurs.

As underperformance can be seen as the result of a mismatch between the student and the academic environment,[7,8] explanations can be identified from both perspectives. It has been suggested specifically that the more subjective examination methods used in clinical assessments may lead to examiner bias and therefore disadvantage ethnic minority students.[9] However, this does not explain underperformance on examinations marked by computers, which are common in pre-clinical courses.[3] Another possible explanation is that the initial situation of ethnic minority students is less favourable. However, lower pre-university grades[10] and socio-demographic variables, such as first language[7,11–13] and socio-economic status,[13] can only explain a small part of the ethnicity-related disparities in performance found in previous studies. As these variables have been studied primarily in isolation, studies that adopt a multivariable approach and take into account the different stages of medical training are required.[3,11] Additionally, little is known about performance differences across ethnic groups. Usually, the academic performance of ethnic minority/non-White students as a single group is compared with the performance of ethnic majority/White students.[3] However, this approach ignores the reported variation in performance among different ethnic minority groups.[12,13]

This study aimed to determine whether underperformance occurs across ethnic minority groups in undergraduate pre-clinical and clinical training and the extent to which this underperformance can be explained by age, gender, pre-university grade point average (pu-GPA) and additional socio-demographic characteristics. The investigation involved a longitudinal, prospective cohort study of six successive cohorts of medical students.

METHODS

Context

This study was conducted at the Erasmus MC Medical School, Rotterdam, the Netherlands, which has a relatively large number of ethnic minority students compared with other Dutch medical schools. The integrated and theme-oriented curriculum of the Erasmus MC Medical School was implemented in 2001 and consists of a 4-year pre-clinical phase followed by a 2-year clinical phase. Year 1 includes 10 written examinations and three practical examinations. The remainder of the pre-clinical years include 22 written examinations and nine practical examinations. The clinical phase consists of two parts with a fixed sequence of clinical rotations. A period of 15 weeks of general clinical training precedes 69 weeks of discipline-specific clerkships comprising 12 different rotations. Clinical grades are based on global performance ratings (GPRs) attained during the clerkships, and a patient-related and oral examination undertaken at the end of each clerkship. The GPR represents a global rating awarded by a supervisor, which covers a student's performance on a number of clinically relevant competencies over a certain period.[14] Clinical grades range from 5 (unsatisfactory) to 10 (outstanding).

Participants and procedure

This study included all 2357 students who entered Erasmus MC Medical School during 2002–2007. These six consecutive cohorts were selected for two reasons: (i) the curriculum was unchanged during this period, and (ii) data on ethnicity were available for these cohorts from a national database of students in higher education in the Netherlands (1cijferHO).

Data on academic performance were derived from the university student administration system and anonymity was guaranteed. Because data were collected as part of regular academic activities, individual consent was not necessary.

Additional data on ethnicity and social background were collected for 284 Year 4 students in 2006 (86%) and 387 Year 1 students in 2007 (95%). These students completed a questionnaire at the end of a compulsory practical session. This questionnaire was developed by a committee dedicated to *diversity among students*, which included both students and faculty members. The questionnaire included items on factual aspects of ethnicity and social background (Table 1). This part of the study was designed with the help and approval of the Dutch Data Protection Authority. Students were informed about the study, participation was voluntary and anonymity was guaranteed.

Variables

According to Statistics Netherlands (CBS; www.cbs.nl), an individual belongs to an ethnic minority group if at least one of his or her parents was born outside the Netherlands. Based on the countries of birth of their parents, ethnic minority students were classified into one of five ethnic subgroups:

Table 1 Data recorded for each student

Source and type of data	Comment
From 1cijferHO	
Ethnicity	1 Dutch
	2 Turkish/Moroccan/African
	3 Surinamese/Antillean (Dutch Guyana)
	4 Asian (including Chinese)
	5 Western
	6 Other
First-generation immigrant	Ethnic minority students born outside the Netherlands
By questionnaire*	
First language	'Dutch' or 'Non-Dutch'
First-generation university student	Students whose parents did not attend university (either a research university or a university of applied sciences)
Medical doctor as parent	Parental profession as provided by the students was used to determine whether or not they had at least one parent who was a medical doctor
Urban background	Self-defined
From university student administration database	
Gender	
Age	At course entry, categorised as < 19 years, 19–21 years, > 21 years
Pre-university GPA	Mean grades obtained during the final year of pre-university education (10-point scale: 1 = very poor, 10 = excellent). Final grades based on school examinations (50%) and the national examination (50%)
	Not available for all students
Cohort	2002–2007
Nominal Year 1 course completion	Passed all Year 1 examinations within 1 year
Nominal pre-clinical course completion	Passed all pre-clinical examinations within 4 years
Good clinical performance	Achieved at least three of five clerkship grades of ≥ 8.0

* Collected for Year 4 students in 2006 and Year 1 students in 2007
GPA = grade point average

Surinamese/Antillean; Turkish/Moroccan/African; Asian; Western, and 'Other'[13] (Table 1). The 'Other' category included only a small number of students and its data were excluded from the statistical analyses.

Gender, Pre-university GPA (pu-GPA) and age are known to be associated with performance at medical school.[7,11,15–17] Pre-university GPA was included in the analyses as a continuous variable. As pu-GPA was not available for students with a foreign or a non-standard Dutch pre-university education, a categorical variable – 'missing pu-GPA' – was added to the analyses. Admission criteria for students with a foreign pre-university education are similar to those for students with a Dutch pre-university education: diplomas should be of a comparable level and certain subjects are required. Entrance examinations include examinations in Dutch, English, chemistry, biology and mathematics.

Three measures were defined to represent medical school performance: nominal completion of the Year 1 course; nominal completion of the pre-clinical course, and good clinical performance. 'Nominal completion' refers to completion within the prescribed time (i.e. without delay). Failure to complete clinical training is rare (about 1% at this medical school), but clinical grades are known to play a key role in selection for residency.[18] Therefore, 'good clinical performance' was defined as the achievement of at least three of five grades of ≥ 8.0. Marks of ≥ 8.0 represent 'good' (8.0) or 'very good' (9.0) performance. The average grade on the first five clerkships at this medical school is just below 8.0.[19] We considered that achieving an above-average grade more than half of the time (at least three of five grades) represented good clinical performance. In addition, a grade of 8.0 is often considered the minimum required for admission to specialty training. In order to also include students who entered clinical training with delay (reflecting study delay in the pre-clinical course), we restricted the analysis of clinical performance to the cohorts of 2002–2004 and to the first five clerkships (internal medicine, surgery, paediatrics, psychiatry, neurology). Grades on the first five clerkships have been shown to be representative of grades on all 10 clerkships.[19]

Statistical analysis

We assessed associations between ethnicity and the other independent variables using chi-squared tests for categorical variables and analysis of variance (ANOVA) for pu-GPA. We used logistic regression to calculate an odds ratio (OR) for the effect of ethnicity on each of the three outcome measures (Table 1). Statistical interaction terms were used to study the potentially differential effects of ethnicity by student characteristics. For example, to assess whether ethnicity had the same associations with Year 1 course completion for men and women, we included the interaction term 'ethnicity × gender' in a model that also included ethnicity and gender as main effects.

We hypothesised that any differences in performance during medical school might be explained by confounders or additional socio-demographic characteristics associated with ethnicity. These variables were sequentially considered in multivariable regression models for each of the three outcomes. Firstly, we adjusted for key confounders (age, gender, pu-GPA). Secondly, we adjusted for key confounders and socio-demographic characteristics (first-generation immigrant, language spoken at home, urban background, first-generation university student, medical doctor as parent). Finally, we adjusted for key confounders, socio-demographic variables and previous performance at medical school.

Missing values on the four variables collected by questionnaire (Table 1) were statistically imputed based on their correlation with the other variables in the logistic regression models (Table S1, online).[20] Missing values were imputed five times using five independent draws from the imputation model. The combined estimates over the imputed datasets were used. Odds ratios were compared between analyses of the imputed dataset (multiple imputed) and the unimputed dataset (complete case) (see Table S1 for details). As the absence of data on these four variables was systematically related to cohort, we considered the missing-at-random assumption to be reasonable.

Analyses were performed using PASW Statistics Version 18.0 (SPSS, Inc., Chicago, IL, USA). We present 95% confidence intervals (CIs) for unadjusted and adjusted ORs, which indicate statistical significance if they do not include a value of 1.0.

RESULTS

Student characteristics

Data for Year 1 and pre-clinical performance pertained to 1661 (70%) Dutch and 696 (30%) non-Dutch students. Non-Dutch students were older, had a lower or a missing pu-GPA and more often had

Table 2 Characteristics of 2336 students in the cohorts of 2002–2007

	2002–2007 (*n* = 2336*)										
	Dutch (*n* = 1661, 71%)		**Surinamese/Antillean (*n* = 162, 7%)**		**Turkish/Moroccan/African (*n* = 126, 5%)**		**Asian (*n* = 147, 6%)**		**Western (*n* = 240, 10%)**		
	n	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	**p-value**
Socio-demographic characteristics											
First-generation immigrant	–	–	62	38	21	17†	103	70‡	67	28†	< 0.001§
First language non-Dutch (*n* = 667)	3	0.6	14	29‡	25	74†	35	85†	26	41‡	< 0.001§
First-generation university student (*n* = 659)	141	30	15	31	21	68‡	15	39	10	16†	< 0.001
Medical doctor as parent (*n* = 658)	69	15	9	19	1	3	3	8	8	13	0.23
Urban background (*n* = 627)	194	43†	34	83‡	26	81‡	30	75‡	41	68‡	< 0.001
Confounders											
Male	613	37	57	35	39	31	76	52‡	97	40	0.003
Age, years											< 0.001
< 19	978	59‡	84	52	55	44	45	31	109	45	
19–21	510	31	56	35	52	41	64	44‡	99	41‡	
> 21	173	10	22	14	19	15	38	26‡	31	13	
Pre-university GPA											
Missing¶	50	3†	37	23‡	8	6	17	12‡	18	8	< 0.001
Mean (SD)	7.04 (0.55)		6.86 (0.60)**		6.94 (0.63)		6.83 (0.55)¶		6.96 (0.57)		< 0.001
Cohort											0.11
Dependent variables											
Passed Year 1 course in ≤ 1 year	1064	64‡	60	37†	70	56	73	50†	145	60	< 0.001
All pre-clinical examinations in ≤ 4 years	674	41‡	31	19†	39	31	35	24†	88	37	< 0.001

* The percentages relevant to each variable refer to the number of participants for which data is available
† Percentage significantly lower than overall average
‡ Percentage significantly higher than overall average
§ Category 'Dutch' excluded from analysis
¶ Number of students with a foreign pre-university education: Dutch, *n* = 11; Surinamese/Antillean, *n* = 31; Turkish/Moroccan/African, *n* = 3; Asian, *n* = 13, and Western, *n* = 13
** Pre-university GPA significantly lower than for Dutch students
GPA = grade point average; SD = standard deviation

Table 3 Characteristics of 818 students in the cohorts of 2002–2004 who finished the first five clerkships

	2002–2004 (*n* = 818*)										
	Dutch (*n* = 623, 76%)		**Surinamese/Antillean (*n* = 37, 4.5%)**		**Turkish/Moroccan/African (*n* = 37, 4.5%)**		**Asian (*n* = 40, 5%)**		**Western (*n* = 81, 10%)**		
	n	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	**p-value**
Socio-demographic characteristics											
First-generation immigrant	–	–	15	41	7	19†	29	73‡	20	25†	< 0.001§
First language non-Dutch (*n* = 251)	–	–	5	39	9	82‡	9	82‡	5	21†	0.001§
First-generation university student (*n* = 249)	66	35	4	31	8	73‡	5	50	3	13†	0.01
Medical doctor as parent (*n* = 250)	25	13	3	23	–	–	–	–	4	17	0.31
Urban background (*n* = 226)	67	39†	8	80‡	7	78‡	8	73	14	64	0.001
Confounders											
Male	207	33	12	32	13	35	23	58‡	27	33	0.041
Age, years											< 0.001
< 19	389	62‡	19	51	17	46	12	30†	40	49	
19–21	169	27†	14	38	14	38	13	33	33	41‡	
> 21	65	10†	4	11	6	16	15	38‡	8	10	
Pre-university GPA											
Missing¶	19	3†	5	14‡	3	8	6	15‡	4	5	< 0.001
Mean (SD)	7.03 (0.55)		6.88 (0.64)		6.87 (0.62)		6.89 (0.52)		6.91 (0.52)		0.07
Cohort											0.10
Dependent variable											
At least three clerkship grades of ≥ 8.0	545	88‡	20	54†	25	68†	23	58†	62	77†	< 0.001

* The percentages relevant to each variable refer to the number of participants for which data is available
† Percentage significantly lower than overall average
‡ Percentage significantly higher than overall average
§ Category 'Dutch' excluded from analysis
¶ Number of students with a foreign pre-university education: Dutch, *n* = 4; Surinamese/Antillean, *n* = 3; Turkish/Moroccan/African, *n* = 1; Asian, *n* = 5, and Western, *n* = 2
GPA = grade point average; SD = standard deviation

*Table 4 Relationship between ethnicity and Year 1 course completion, pre-clinical course completion and clinical performance**

	Year 1 course completion (n = 2336)		Pre-clinical course completion (n = 2336)		Clinical performance (n = 818)	
Characteristic	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Ethnicity effect unadjusted						
Dutch	1.00	–	1.00	–	1.00	–
Surinamese/Antillean	**0.33**	0.24–0.46	**0.35**	0.23–0.52	**0.17**	0.09–0.34
Turkish/Moroccan/African	0.70	0.49–1.01	**0.66**	0.44–0.97	**0.30**	0.14–0.62
Asian	**0.55**	0.40–0.78	**0.46**	0.31–0.68	**0.19**	0.10–0.38
Western	0.86	0.65–1.13	0.85	0.64–1.12	**0.47**	0.27–0.82
Ethnicity effect adjusted for confounders† and cohort						
Dutch	1.00	–	1.00	–	1.00	–
Surinamese/Antillean	**0.40**	0.27–0.57	**0.40**	0.26–0.61	**0.19**	0.09–0.38
Turkish/Moroccan/African	0.73	0.49–1.08	0.68	0.45–1.03	**0.33**	0.16–0.70
Asian	**0.67**	0.47–0.98	**0.55**	0.36–0.83	**0.24**	0.12–0.49
Western	0.95	0.70–1.28	0.95	0.70–1.27	**0.51**	0.28–0.91
Ethnicity effect adjusted for confounders†, cohort and socio-demographic characteristics‡						
Dutch	1.00	–	1.00	–	1.00	–
Surinamese/Antillean	**0.40**	0.27–0.60	**0.42**	0.27–0.66	**0.16**	0.07–0.36
Turkish/Moroccan/African	0.78	0.51–1.20	0.71	0.44–1.14	**0.38**	0.15–0.98
Asian	0.72	0.45–1.14	0.64	0.38–1.08	**0.20**	0.08–0.53
Western	0.99	0.71–1.37	0.97	0.72–1.40	**0.45**	0.24–0.85
Ethnicity effect adjusted for confounders†, cohort, socio-demographic characteristics‡, and previous performance at medical school§						
Dutch	–	–	1.00	–	1.00	–
Surinamese/Antillean	–	–	**0.57**	0.35–0.93	**0.17**	0.08–0.39
Turkish/Moroccan/African	–	–	0.76	0.46–1.25	0.39	0.15–1.02
Asian	–	–	0.68	0.39–1.20	**0.22**	0.08–0.60
Western	–	–	1.01	0.71–1.45	**0.45**	0.23–0.85

* Figures in bold denote significant odds ratios ($p < 0.05$)
† Age, gender, pre-university grade point average
‡ Socio-demographic characteristics included first-generation immigrant, first language, first-generation university student, medical doctor as parent, and urban background
§ Year 1 performance for pre-clinical course completion; pre-clinical course completion for clinical performance
OR = odds ratio; 95% CI = 95% confidence interval

an urban background. Asian students were more often male and Turkish/Moroccan/African students were more often first-generation university students (Table 2). On the qualifying date (1 January 2011), 76% (range: 71–85%) of the cohorts of 2002–2004 had passed the first five discipline-specific clerkships. Thus, data for 623 (76%) Dutch and 195 (24%) non-Dutch students (Table 3) were included in the analysis of clinical performance. Differences in socio-demographic characteristics and with respect to age and gender were generally similar to those reported in Table 2.

Year 1 course completion

Dutch students were more likely to complete the Year 1 course within 1 year (64%) compared with Surinamese/Antillean and Asian students (37% and 50%, respectively) (Table 2). These differences correspond to unadjusted ORs of 0.33 ($p < 0.001$) for Surinamese/Antillean students and 0.55 ($p < 0.001$) for Asian students (Table 4). These disparities were partly explained by the confounders (adjusted ORs: 0.40 and 0.67, respectively) and socio-demographic characteristics (adjusted ORs: 0.72 and 0.40, respec-

tively). Details of the regression analyses, with both complete cases and multiple imputations, are presented in Table S1. We found a statistically significant differential effect of ethnicity by pu-GPA (interaction test, $p < 0.001$, d.f. = 4), with especially low Year 1 completion rates among Surinamese/Antillean and Asian students for whom a pu-GPA was missing (11% and 18%, respectively, versus 78% for both Western and Dutch students).

Pre-clinical course completion

Dutch students were also more likely to complete the pre-clinical course within 4 years (41%) compared with Surinamese/Antillean and Asian students (19% and 24%, respectively) (Table 2). Unadjusted ORs were 0.35 and 0.46 for Surinamese/Antillean and Asian students, respectively (Table 4). The confounders, socio-demographic characteristics and previous performance at medical school all failed to explain these differences.

Clinical performance

Of the 623 Dutch students who finished the first five clerkships, 545 (88%) received three or more grades of ≥ 8.0. This percentage was significantly lower for all other ethnic subgroups, ranging from 54% to 77%. The differences in percentages correspond to unadjusted ORs, ranging from 0.17 for Surinamese/Antillean students to 0.47 for Western students. Again, these differences were not explained by confounders, socio-demographic characteristics or previous performance at medical school (Tables 4 and S1).

DISCUSSION

This study found that in pre-clinical training, only two of four ethnic minority groups (Surinamese/Antillean and Asian) underperformed, whereas in clinical training all minority groups achieved lower grades. The ethnicity-related disparities in performance, especially in clinical training, remained after adjustments for age, gender, pu-GPA and socio-demographic variables, including parental education and first language, and previous performance at medical school.

Explanation of the study's findings

The distinctions among ethnic groups may point to different mechanisms for ethnicity-related disparities in medical school performance. The underperformance of Surinamese/Antillean and Asian students in pre-clinical training is explained only partly by age, gender and pu-GPA. Thus, students in these subgroups who had received Dutch secondary education also performed less well than students from other ethnic groups. Surprisingly, factors related to social background further explained the differences for Asian students, but not for Surinamese/Antillean students. Although this is counterintuitive, it may be explained by the fact that Surinamese/Antillean students often speak Dutch at home. It may be that first language is a proxy for cultural differences in communication rather than for language skills.[21] Therefore, cultural differences in communication between Dutch and Surinamese/Antillean students may be masked by the fact that these students speak the same language. Further research, specifically in the medical school context, is required to explore other causes of poorer performance, such as differences in motivation for studying medicine.[22]

All of the non-Dutch subgroups achieved lower grades in clinical training, even after adjustments for pre-clinical performance. This suggests that the mechanisms by which this occurred differ between pre-clinical and clinical training. A first possible explanation refers to a deficit in practical clinical knowledge in ethnic minority students, as suggested by Woolf and colleagues.[23] These authors found ethnic differences in practical clinical knowledge and skills, but not in theoretical medical knowledge.[23] Further research is required to determine whether non-Dutch students are less well prepared for clinical training, despite receiving the same pre-clinical training and, if so, why this is.

As clinical grades are, at least partly, based on medical students' interactions with faculty staff or patients, differences in communication styles may represent a second explanation for the lower grades. Although several studies have reported that students from ethnic minority groups achieve lower scores on the communication part of clinical performance examinations,[21,24] differences in communication styles failed to explain all of the variance in clerkship grades.[25]

A third explanation may refer to stereotype threat, which suggests that underperformance in ethnic groups can be caused by increased anxiety that arises in response to the prospect of being negatively stereotyped.[26] Thus far, stereotyping has been reported for Asian medical students in the UK,[27] but further research is required to confirm that stereotyping applies to other ethnic minority groups at

medical school. A related issue worthy of attention concerns whether, as a result of the more subjective process of grading, stereotype threat is more prominent in clinical than pre-clinical training.

A final possible explanation is that the more subjective grading in clinical training[28] leads to examiner bias. Inevitably, people tend to trust those who are similar to themselves or who are similar to people they like (a phenomenon known as the 'similarity principle'[29]) and people will have more positive views of those they believe to be part of their group (referred to as 'in-group bias'[30]). Therefore, it is likely that Dutch examiners will tend to give Dutch students higher marks than non-Dutch students, unless they are aware of and attempt to control these automatic reactions[26] or use more objective criteria to mark the students.[9] In line with the growing prominence of faculty development in medical education,[31] the training of examiners has received increasing attention at our medical school. However, as examiners at our medical school are mainly Dutch and have not yet received specific training in cultural competency, the possibility of examiner bias cannot be ruled out.

A recent review[3] suggested that examiner bias and candidate communication skills were not the main causes of ethnic differences in performance because similar effects were found in both machine- and examiner-marked tests. However, in the present study we found dissimilar effects at the group level between pre-clinical assessments, which are mainly marked by machine, and clinical assessments, which are mainly marked by examiner. Further studies are needed to replicate and explain our findings. More detailed experimental or ethnographic studies might assist us to understand what happens in clinical assessments.

Comparisons with other studies

Our study confirms that ethnic minority students underperform throughout medical school,[3] but also reveals differences in performance among ethnic minority groups. According to a recent review, several studies on ethnicity and academic performance have adjusted their data for gender, and some have done so for age, pre-university grades, first language or socio-economic group.[3] We systematically adjusted for the combination of all of these factors. Our analyses confirmed the expected associations of the confounders with performance at medical school (Table S1). The main predictor of underperformance in pre-clinical training was a lower pu-GPA,[11] whereas male gender was associated with poorer performance in both pre-clinical and clinical training.[11,17,32] Students aged > 21 years performed relatively well in pre-clinical training after adjustment for the other variables.[17] The additional socio-demographic factors were less important for performance at medical school, except for the 'first-generation university student' factor, which was associated with lower clerkship grades. Further studies are required to explore why these students achieve lower clerkship grades despite showing comparable, or even better, performance in pre-clinical training.

Strengths and limitations of the study

Our study used data for a large number of students (2336 from six entire year cohorts), of whom 696 (30%) had a non-Dutch background. The large sample size and the large number of non-Dutch students gave us the opportunity to extend our analysis beyond a White/non-White comparison, to which most studies on ethnicity and academic performance are restricted.[3] The use of a longitudinal design, which is also uncommon in studies on factors associated with academic performance in medical school,[11] enabled us to note performance differences among ethnic groups in pre-clinical and clinical training. Unlike previous studies, we were not compelled to use less reliable methods such as self-report, or to use names or photographs,[3] and only one student whose ethnicity was unknown had to be excluded from the analysis.

A limitation of our study is that data on four of the additional socio-demographic factors (first language, first-generation university student, urban background, medical doctor as parent) were collected for a restricted number of participants. However, the multiple imputation technique applied is generally accepted as a suitable method for dealing with missing values.[20] The imputation of missing values allows the use of data that are available for other predictors and that would otherwise be lost. Generally speaking, imputation methods, especially multiple imputations, are therefore superior to complete case analysis.[20,33,34] In our study, the ORs calculated in the imputed dataset were similar and, if different, were generally more conservative than the ORs in the unimputed dataset (Table S1).

Implications for practice

This study has some practical implications for medical schools that are confronted with increasingly diverse student populations. As students from certain

groups are more likely to fail than other students, the provision of targeted or proactive support for these groups might be appropriate. For example, additional support during Dutch pre-clinical training may be required for Surinamese/Antillean and Asian students, especially for those who do not have a Dutch pre-university education.

The lower clerkship grades achieved by all non-majority students also call for action. In addition to possible causes related to the student or the academic environment, the consequences require attention: do non-majority students enter residency training less often, especially the specialty of their first choice? Finally, interventions for improvement should be considered. A first step is to make assessment less subjective or at least to ensure that students from ethnic minorities are not disadvantaged. To this end, diversity should be considered in both test construction and implementation.[9]

A second step is to create awareness of cultural bias and to develop a greater understanding of cultural differences through cultural competency training for both faculty staff and students.[25] This is in line with the increase in the attention paid to cultural competency training as a mechanism to improve intercultural patient–doctor interaction.[35]

In conclusion, strong ethnicity-related disparities exist in medical school performance even after adjustments for age, gender, pu-GPA and socio-demographic variables. A more subjective grading process cannot be ruled out as a cause of the lower grades in clinical training achieved by students from ethnic minority groups, but other explanations require further investigation. In order to give all students a fair chance of academic success, medical schools must set up support programmes that are appropriate for diverse student populations and implement examination systems that take this diversity into account.

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SUPPORTING INFORMATION

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Table S1. Detailed description of the multivariable models used to adjust the relationship of ethnicity with performance throughout medical school.

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